NATURAL FEATURES SUMMARY AND PRESERVE DESIGN FOR CAROLINA BAYS IN BLADEN AND CUMBERLAND COUNTIES, NORTH CAROLINA

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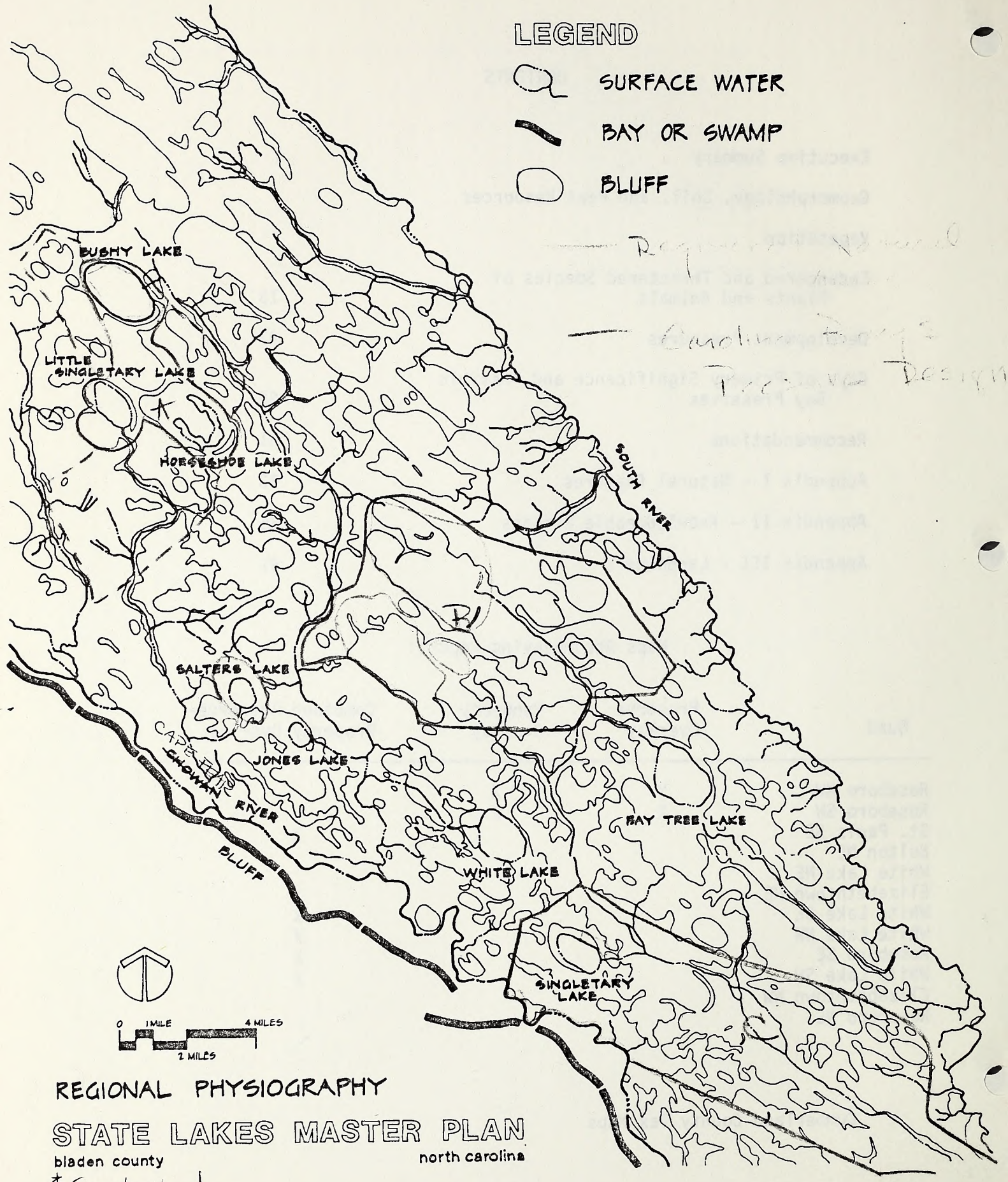
CONTENTS

Maps Accompanying Report:

Quad	Preserve Overlay	Property Overlay	Combined Preserve-Property Overlay
Roseboro NW	X	X	
Roseboro SW	X	X	
St. Pauls SE			X
Bolton NE			
White Lake NE			
Elizabethtown NE			X
White Lake SE			X
White Lake NW			X
Roseboro SE			X
White Lake SW			X
Elizabethtown NW			
Roseboro NE			

Cumberland County Tax Maps



REGIONAL PHYSIOGRAPHY

STATE LAKES MASTER PLAN

bladen county

north carolina

Cumberland

EXECUTIVE SUMMARY

Carolina Bays are elliptical depressions found in the Atlantic Coastal Plain, concentrated in North Carolina, South Carolina and northern Georgia. Their numbers are estimated at about 500,000, and they vary from less than a hundred feet in length to over 20,000 feet. Among their most striking features are their smoothly elliptical shape, always oriented along a northwest-southeast axis, the sand rim, best developed at the eastern end, and their frequent occurrence in bay complexes of overlapping or included bays.

Geomorphically, Carolina Bays belong to a group of features known as oriented lakes, which have principal other occurrences in Alaska and Chile. Oriented lakes in general, and Carolina Bays specifically, have received much attention from geomorphologists and geologists, with many contrasting theories being expounded. No entirely satisfactory explanation exists.

In general, the bays are concentrated in the nearly flat uplands between major stream drainages, but they do occur elsewhere. They are quite shallow depressions, and for this reason are very rarely open-water lakes. Nearly all have become gradually filled with principally organic sediments in the thousands of years following their formation. They now support dense vegetation of a more-or-less wetland character.

Owing to their wet, mucky soils, dense and inhospitable vegetation, poor timber production, and general uselessness, they have, until the last

decade, been considered wastelands or gamelands and have been left essentially undisturbed. As wildlands, bays comprised habitat for many endemic species adapted to their conditions and a haven for other species once more wide-ranging but driven out of drier uplands more suitable for agricultural and urban development.

With improved techniques for ditching and draining, bays are no longer considered unusable, and many have been converted to pine plantation or agricultural land. Bay lakes have been increasingly susceptible to recreational development. Most recently, increased concern about energy resources in this country has led to interest in mining peat in Carolina Bays. A combination of these factors has led to a rapid destruction of what had previously been large tracts of wild land in the Coastal Plain of the Carolinas.

The Bladen Lakes region of Bladen and Cumberland counties, North Carolina contains the greatest concentration of large bays not only in North Carolina but throughout their range. In association with the clay-based bays in adjoining counties to the west, the Bladen-Cumberland bays comprise the principal geomorphic, pedologic and biological diversity known to occur. Additionally, the Bladen Lakes area is the center of distribution for a number of narrowly endemic species, such as white wicky (Kalmia cuneata), Venus' flytrap (Dionaea muscipula), and the pine barrens treefrog (Hyla andersoni). Large predatory animals, once more generally distributed in the coastal plain but now isolated to the Bladen bays and a few other large wetlands, include the black bear (Ursus americanus), alligator (Alligator mississippiensis), and cougar (Felix concolor), all considered endangered by federal or state governments.

The Bladen Lakes region already has large tracts of land in public ownership (primarily Bladen Lakes State Forest). As rapid agricultural and recreational development of adjoining private lands has taken place it has become obvious that the present ownership and management situation does not adequately protect the diversity of bay types.

If the present trends continue, most bays not in state ownership will be destroyed in the next decade, leaving an inadequate representation of these unique geomorphic features. Endangered large predators, which require many square miles of contiguous wild lands, will be eliminated from the area. Endemic species, such as white wicky, will lose a large proportion of their populations and will become further endangered through this habitat loss.

For all of these reasons, it is recommended that a large bay preserve be established in Bladen and Cumberland counties, North Carolina, using a variety of protection techniques. The Bushy Lake/Marshy Bay/Suggs Mill Pond area is being proposed as the preferred preserve site. Owing to the large area sought, it may be necessary to limit outright purchase to tracts of primary importance. Secondary and peripheral areas, as well as wildlife corridors connecting extensive wildlands, may be more cost-effectively protected through easements and management agreements. Because of the rapid development of bays in Bladen and Cumberland counties implementation of this preserve design should be a high priority.

GEOMORPHOLOGY, SOIL AND PEAT RESOURCES

Carolina Bays are shallow, elliptical depressions in the Atlantic Coastal Plain, primarily in North Carolina, South Carolina and northern Georgia. There are estimated to be 500,000 of them ranging in length from less than a hundred feet to several miles. Even the largest, however, only attain depths of a few tens of feet. First recognized in the 1800's, they did not become well-known until the advent of aerial photography in the 1930's. Subtle features to a person on the ground, they are strikingly visible and curiosity-producing from the air.

Nearly all the bays are elliptical and oriented with their long axis extending from northwest to southeast. Most have a sand rim extending the length of the periphery, but by far best developed on the southeastern end and northeastern flank. In areas where bays occur densely, overlapping, superimposed, or entirely included bays are common. Some bays show multiple concentric rims. Some of the larger bays with well-developed sandrims show arcing dune fields extending to the northeast.

Great interest in the bays, coupled with their inhospitable nature, led to a great many scientific papers based on little first-hand experience and a great deal of armchair (or airplane seat) theorizing. Explanations put forward for the existence and peculiar characteristics of bays included:

1. Spring Basins
2. Craters of a Swarm of Meteors

3. Lakes Elongated in Direction of Maximum Wind
4. Solution Depressions (Sinkholes) with Aeolian Deposits Forming the Rims
5. Sinkholes over Limestone, Streamlined by Groundwater Flow
6. Aeolian Blowouts
7. Fish Nests Made by Giant Schools of Fish Congregated over Submarine Springs.

More recently, research has focused on theories which argue that lake formation and the oriented elliptical shape are not necessarily of common origin. Perhaps the most plausible explanation put forward to date involves the creation of many small lakes by a water table suspended above a clay layer, followed by streamlining and orientation by littoral and aeolian processes determined by prevailing winds. This theory is by no means universally accepted, however, and many questions remain.

Carolina Bays have been compared with other areas of oriented lakes, notably in Alaska and Chile, but the degree to which these other areas are analogues of Carolina Bays is unknown and possibly small, given the great differences in climate, substrate, wind conditions, and vegetations at time of formation. Carolina Bays appear to be either unique geomorphic phenomena or more or less related to a very few other oriented lake fields in the world.

In substrate, the only common features of the bays are that they are developed on Pleistocene clastic sediments and that all show an impermeable layer of clay or humate-cemented sand which maintains a high water table. Clay-based bays are prevalent in some areas and seem to be typically small and scattered. These bays show a wide variety of plant communities. Large bays are more likely to be sand-bottomed, with or without an overlying

VEGETATION

Carolina Bays support a great variety of vegetation types. The particular plant community found is a product of an inter-related set of factors including substrate, hydroperiod, fire and mineral nutrient availability. Pocosin vegetation, consisting of a tangle of evergreen shrubs and vines with a scattering of pond pine, is most typical of the Bladen Bays, and occurs in several relatively distinct zones. Bay forests, with many of the same species as pocosin, but with a closed canopy, occupies drier and sandier situations. Many areas now dominated by pocosin were at one time white cedar swamps, but natural processes and timbering operations have reduced white cedar swamps to rare groves in isolated locations. Some bays with naturally or unnaturally high water levels support marsh vegetation, cypress-gum swamp forest, or pure stands of cypress. Floating or rooted aquatic zones also occur in bays with open water.

In Carolina Bay areas the associated sand rims, uplands and river floodplains form important parts of the landscape. The vegetation types of these areas add to the great natural diversity of this area.

The following vegetation types will be discussed briefly:

1. Bay Forest (Pond Pine Forest)
2. High Pocosin (Pond Pine Woodland)
3. Medium Pocosin
4. Low Pocosin

5. Pitcher Plant Bog
6. White Cedar Swamp
7. Marsh
8. Open Water (Aquatics)
9. Cypress-Gum Swamp
10. Mixed Hardwood Swamp
11. Pine Flatwoods
12. Longleaf Pine-Turkey Oak Woodland.

1. Bay Forest (Pond Pine Forest)

This is the typical vegetation of relatively dry and sandy bays, as well as of some adjoining upland areas. The peaty sand substrate is saturated to within a few feet of the surface throughout the year, but standing water is rare. Nutrient availability is fair. Pond pine (Pinus serotina) forms a closed canopy, with sweet bay (Magnolia virginiana), red bay (Persea borbonia), and loblolly bay (Gordonia lasianthus) all reaching large size. Loblolly bay may even make up a considerable portion of the canopy. Loblolly pine (Pinus taeda) and red maple (Sphagnum spp.) are rare or absent, as are herbaceous plants.

2. High Pocosin (Pond Pine Woodland)

High pocosin is a slightly wetter and peatier community than the previous, and in a large, well-developed bay typically occupies a zone closer to the center. Here the soils are more organic, with one to two feet of peat at the surface. Pond pines are more scattered but still large. The top of the shrub layer is ten to twenty feet, with a wide variety of pocosin shrubs sharing dominance - inkberry (Ilex glabra), gallberry (Ilex coriacea), red bay (Persea borbonia), titi (Cyrilla

racemiflora), fetterbush (Lyonia lucida), bayberry (Myrica heterophylla), and sweet pepperbush (Clethra alnifolia). Loblolly bay and sweet bay are found as scattered large individuals. Catbrier (Smilax laurifolia) exists as abundant high-climbing vines. Peat moss and herbs are rare.

3. Medium Pocosin

Medium pocosin occupies yet wetter and peatier sites and is typically found further towards the center of bays than the previous two communities. The water table stays throughout the year in the two to four foot thick peat layer. Nutrient availability is low. Pond pines are small, stunted and gnarled, and very scattered. Sweet bay and loblolly bay are also stunted and scattered. Pocosin shrubs form a dense layer four to ten feet high, tied together by catbrier. Peat moss is very common.

4. Low Pocosin

Low pocosin is found in the wettest sites over the deepest peats, usually greater than four feet deep. Nutrient availability is very poor. The water table stays at or near the surface throughout the year. Pond pines and bay trees are stunted to shrub size. Mixed pocosin shrubs up to 4 feet tall dominate, with lambkill (Kalmia augustifolia), zenobia (Zenobia pulverulenta) and cassandra (Cassandra calyculata) added to those listed in #2 above. Peat moss forms a near continuous mat. Insectivorous plants, orchids and graminoids are common herbaceous types. Catbrier sprawls over all shrubs.

5. Pitcher Plant Bogs

Pitcher plant bogs are rather rare communities closely associated with low pocosin. They seem to occur where a peat burn has lowered the

level of substrate so that a slightly more aquatic environment exists. These areas are dominated by yellow pitcher plant (Sarracenia flava). Other plants include sundews (Drosera spp.), bladderworts (Utricularia spp.), bogbuttons (Eriocaulon spp., Lachnocaulon spp.), yellow-eyed grass (Xyris spp.), maidencane (Panicum hemitomon) and beakrushes (Rhynchospora spp.).

6. White Cedar Swamp

White cedar swamp occurs in wet areas typically where there is a stream (or braided stream system) with flowing water. Atlantic white cedar (Chamaecyparis thyoides) is the dominant, often forming nearly pure stands. White cedar is much less common than in the past, largely owing to extensive and persistent timbering. Evidence from peat cores shows that even prior to settlement white cedar had declined, as bay wetlands filled in with peat and domed up, creating the extremely nutrient-poor low pocosins. At present, small white cedar stands are uncommon near bay edges. White cedar swamps are a threatened community type throughout their range.

7. Marsh Vegetation

Marsh vegetation develops in bays only rarely, and usually under the influence of man. Marshes are wetlands dominated by herbaceous plants, principally grasses, sedges and rushes.

8. Open Water (Aquatic)

Open water communities occur uncommonly in bays, but are well represented in the Bladen Lakes area. They consist of rooted aquatics such as water lily (Nymphaea odorata), watershield (Brasenia schreberi), and cow-lily (Nuphar sagittifolium), as well as floating aquatics such as bladderworts (Utricularia spp.) and fanwort (Cabomba caroliniana).

9. Cypress-Gum Swamps

Cypress-gum swamps are of two distince types. Peat flooded with water one to six feet deep supports a forest of pondcypress (Taxodium ascendens) and swamp blackgum (Nyssa sylvatica var. biflora). In deep water no shrubs are present, but in shallow water pocosin shrubs may form a dense layer, forming a community sometimes known as pondcypress pocosin. The second type is found in river swamps, where sloughs and backwaters are dominated by baldcypress (Taxodium distichum) and either swamp blackgum or swamp tupelo (Nyssa aquatica).

10. Mixed Hardwood Swamps

Mixed hardwood swamps also are found both in bays and in nearby river swamps. In bays they tend to be dominated by red maple, and are usually the product of some artificial manipulation of the water table. They are not a common type. Riverine hardwood swamps occupy large tracts of land along the Cape Fear, South, and Black Rivers and many smaller tributaries. Important tree species include red maple, swamp blackgum, swamp tupelo, pumpkin ash (Fraxinus tomentosa), red ash (Fraxinus pennsylvanica), water ash (Fraxinus caroliniana), American elm (Ulmus americana), willow oak (Quercus phellos), water oak (Quercus nigra), sweetgum (Liquidambar styraciflua), laurel oak (Quercus laurifolia), swamp chestnut oak (Quercus michauxii), water hickory (Carya aquatica), swamp cottonwood (Populus heterophylla), overcup oak (Quercus lyrata), cherrybark oak (Quercus pagoda), swamp willow (Salix caroliniana), river birch (Betula nigra) and baldcypress. Shrubs and herbs are sparse.

11. Pine Flatwoods

Pine flatwoods are the typical forests of the fairly moist, but not wet, uplands. Loblolly pines, with lesser amounts of sweetgum and red maple,

form the canopy. Common shrubs include wax myrtle (Myrica cerifera), inkberry, gallberry and fetterbush.

12. Longleaf Pine-Turkey Oak Woodland

Longleaf pine-turkey oak woodland predominates on the sand rims of the Carolina Bays and on other dry sand ridges. A scattered canopy of longleaf pine (Pinus palustris), and an open subcanopy of turkey oak (Quercus laevis) are typical. Huckleberries (Gaylussacia frondosa, Gaylussacia dumosa) and poison oak (Rhus toxicodendron) form a variable shrub layer. A number of herbs which are adapted to the very dry, sterile conditions are found: wiregrass (Aristida stricta), prickly pear cactus (Opuntia compressa), wireplant (Stipulicida setacea), Bracken (Pteridium aquilinum), nettle spurge (Cnidoscolus stimulosus), sand spikemoss (Selaginella arenicola), sandwort (Arenaria caroliniana) and reindeer lichens (Cladonia spp.).

The diversity of plant communities supports a corresponding faunal diversity. Some species are adapted to a particular community, such as the red-cockaded woodpecker (Picoides borealis), whereas others, such as the black bear (Ursus americanus), require a number of communities. The variety of wetland communities present in the Bladen Lakes area harbors a particularly high diversity of amphibians.

ENDANGERED AND THREATENED SPECIES OF PLANTS AND ANIMALS

As a result of increasing concern over population reductions of plant and animal species resulting from man's activities, the United States Congress passed the Endangered Species Act of 1973 (Public Law 93-205). This Act's goal is the legal protection of species which have been determined to be endangered or threatened. The process of listing such species has proceeded unevenly, due to lack of definite information on many species, particularly plants. Although over 2,000 plant species have been proposed for endangered or threatened status, less than 100 have been listed. Over 200 animals have been listed, although few of these occur in the continental United States.

In North Carolina, a symposium held in 1975 resulted in a publication (1977) listing endangered and threatened plants and animals of North Carolina. In 1979, the North Carolina General Assembly passed the Plant Protection and Conservation Act which provided legal status for a list of endangered or threatened plant species. The current list is much more exclusive than the earlier publication. Although the later list (published through the Pesticide and Plant Protection Division of the North Carolina Department of Agriculture) has legal status and has a better scientific basis, the earlier list is still often used as an indicator of rare plants in the state, and plants on it are still monitored as possible present or future candidates for listing.

Table 1 presents the status of various rare plants of the Bladen Lakes area according to both North Carolina lists and to the federal list. Official status of animal species according to the federal list and North Carolina symposium list is shown in Table 2. A number of the

TABLE 1

ENDANGERED OR THREATENED PLANTS IN THE BLADEN LAKES AREA

NAME	NC STATUS, SYMPOSIUM [1]	NCDA[2]	US STATUS[3]
Amorpha georgiana Wilbur (Georgian amorpha)	EP	--	--
Asclepias pedicellata Walter (stalked milkweed)	EP	--	--
Asplenium heteroresiliens Wagner (Carolina spleenwort)	ET	E	P-2
Asplenium resiliens Kunze (blackstem spleenwort)	TP	--	--
Aster carolinianus Walter (Carolina aster)	EP	--	--
Calamovilfa brevipilis (Torrey) Scribner (riverbank sandreed)	TT	T	P-2
Carex collinsii Nuttall (Collins's sedge)	EP	--	--
Carex projecta Mackenzie (projecting sedge)	EP	--	--
Dionaea muscipula Ellis (Venus's fly-trap)	TE, Expl.	--	P-2
Drosera filiformis Raf. (threadleaf sundew)	EP	--	--
Eleocharis robbinsii Oakes (Robbins's spikerush)	EP	--	--
Eulophia ecristata (Fernald) Ames (eulophia orchid)	EP	--	P-2
Eupaturium resinosum Torrey ex DC. (resionous Joe-Pye weed)	TD	E	P-2
Fothergilla gardenii Murray (dwarf fothergilla)	TP	--	--

TABLE 1 (CONTINUED)

NAME	NC STATUS SYMPOSIUM [1]	NCDA [2]	US STATUS [3]
Habenaria flava (L.) R. Brown (southern rein-orchid)	TT	--	--
Hexastylis lewisii (Fernald) Blomquist and Oosting (Lewis's heartleaf)	TE	--	P-2
Isopyrum biternatum (Raf.) T. & G. (isopyrum)	EP	--	--
Kalmia cuneata Michaux (white wicky)	EE	SC-E	P-1
Lachnocaulon beyrichianum Sporleder (Beyrich's bog-button)	TP	--	--
Lindera melissaefolia (Walter) Blume (southern spicebush)	ET	E	P-2
Litsea aestivalis (L.) Fernald (pondspice)	EP	--	--
Lycopus cokeri Ahles (Coker's bugleweed)	EP	--	--
Lysimachia asperulaefolia Poiret (roughleaf loosestrife)	EE	E	P-1
Nestronia umbellula Raf. (nestronia)	TT	--	P-2
Nuphar sagittifolium (Walter) Pursh (narrow-leaved spatterdock)	TP	--	--
Parnassia caroliniana Michaux (Carolina parnassia)	TP	--	P-2
Plantago sparsiflora Michaux (few-flowered plantain)	EP	--	--
Psoralea lupinellus Michaux (lupine scurf-pea)	TP	--	--
Ranunculus subcordatus E.O. Beal (Bladen buttercup)	EE	E	P-1

TABLE 1 (CONTINUED)

NAME	NC STATUS SYMPOSIUM[1]	NCDA[2]	US STATUS[3]
Rhexia aristosa Britton (awned meadowbeauty)	EP	--	--
Rhynchospora alba (L.) Vahl (white beakrush)	EP	--	--
Sagittaria teres Watson (slender arrowhead)	EP	--	--
Sarracenia rubra Walter (sweet pitcherplant)	TT, Expl.	--	P-1
Solidago verna M.A. Curtis (spring goldenrod)	EE	E	P-1
Sporobolus teretifolius Harper (wireleaf dropseed)	TT	T	P-2
Tridens carolinianus (Steudel) Henrard	TP	--	--

1. Source: Cooper, J.E., S.S. Robinson and J.B. Funderburg EDS. 1977. Endangered and Threatened Plants and Animals of North Carolina. NC State Museum of Natural History, Raleigh, NC.
   - EE - Endangered Endemic
   - ET - Endangered Throughout
   - TE - Threatened Endemic
   - TT - Threatened Throughout
   - TD - Threatened Disjunct
   - EP - Endangered Peripheral
   - TP - Threatened Peripheral
   - Expl. - Exploited

2. Source: Sutter, R. 1980. Protected Plants in the Coastal Regions of North Carolina. NC Department of Agriculture, Pesticide and Plant Protection Division, Raleigh,NC.
   - E - Endangered
   - SC-E - Special Concern Endangered
   - T - Threatened

3. Source: U.S. Department of the Interior, Fish and Wildlife Service. 1980. Endangered and Threatened Wildlife and Plants: Review of Plant Taxa for Listing as Endangered or Threatened Species. Federal Register 45(242): 82480-82569.
   - P-1 - Proposed, with Sufficient Information on Hand to Warrant Listing as Endangered or Threatened
   - P-2 - Proposed, Probably Warranting Listing as Endangered or Threatened, but with Insufficient Information

TABLE 2

SPECIAL STATUS ANIMALS IN THE BLADEN LAKES AREA

NAME	NC STATUS[1]	US STATUS[2]
Alligator mississippiensis (American alligator)	E	E
Anhinga anhinga (anhinga)	T	--
Ardea herodias (great blue heron)	SC	--
Buteo jamaicensis (red-tailed hawk)	SC	--
Buteo lineatus (red-shouldered hawk)	T	--
Cathartes aura (turkey vulture)	T	--
Coragyps atratus (black vulture)	T	--
Elliptio marsupiobesa (Cape Fear spike)	E	--
Felis concolor (cougar)	E	E
Hybopsis sp. nov. (chub)	SC	--
Hyla andersoni (pine barrens treefrog)	T	--
Micrurus fulvius fulvius (coral snake)	SC	--
Noturus sp. nov. (broadtail madtom)	SC	--
Picoides borealis (red-cockaded woodpecker)	E	E
Plecotus rafinesquei (Rafinesque's big-eared bat)	undet.	--

TABLE 2 (CONTINUED)

NAME	NC STATUS[1]	US STATUS[2]
Procambarus ancylus (crayfish)	SC	--
Procambarus pearsei (crayfish)	SC	--
Rana areolata capito (Carolina gopher frog)	SC	--
Ursus americanus (black bear)	SC	--

1. Source: Cooper, J.E., S.S. Robinson and J.B. Funderburg EDS. 1977. Endangered and Threatened Plants and Animals of North Carolina. NC State Museum of Natural History, Raleigh, NC.
   E - Endangered
   T - Threatened
   SC - Special Concern
   undet - rare, but insufficient information to allow status designation

2. Source: U.S. Department of the Interior, Fish and Wildlife Service. 1979. List of Endangered and Threatened Wildlife and Plants. Federal Register 44(12):3636 - 3654.
   E - Endangered

more significantly rare species will be discussed.

Kalmia cuneata (white wicky) is an endangered endemic distributed in seven North Carolina counties and one South Carolina county. In general, it occurs in small populations which are very susceptible to changes in ecological conditions (water table, fire frequency, competing vegetation). It occupies low pocosin ecotones in the Bladen Lakes area. Several of the largest known populations of the species are found in Bladen area bays, such as Suggs Mill Pond.

Dionaea muscipula (Venus' flytrap) is another species endemic to the coastal plain of North and South Carolina. Although relatively common throughout its small range, there has been concern over commercial exploitation and habitat destruction. It requires moist, sunny conditions which are common in the Bladen Lakes area, and many large populations are known from the bays. This unique plant is the only member of its genus and family.

Lysimachia asperulaefolia (rough-leaved loosestrife) is also an endemic to the coastal plain of the Carolinas, where it is found in pocosins. It occurs at Bushy Lake.

Eupatorium resinosum (resinous Joe Pye-weed) occurs in the Pine Barrens of New Jersey and Delaware, and disjunct from there to a small four-county area centered around the Bladen Lakes.

Asplenium heteroresiliens (Carolina spleenwort) occurs in small populations at widely disjunct locations in the southeastern US. Its habitat is shaded limestone outcrops in the coastal plain. It is found in the Bladen Lakes area only on calcareous sandstone at Walker's Bluff on the Cape Fear river.

Hexastylis lewisii (Lewis' heartleaf) is endemic to the upper coastal plain and lower piedmont of North Carolina and southern Virginia. It is uncommon throughout its range. It has been found in moist (but upland) pine forests in the Bladen Lakes area.

Solidago verna (spring goldenrod) is an endemic to the coastal plain of southeastern North Carolina and northeastern South Carolina. This is a local species occurring in habitats (pocosin, savanna) which are being rapidly altered. It occurs in several places in the Bladen Lakes area.

Sarracenia rubra (sweet pitcher plant) occurs in the coastal plain and mountains of the southeastern US, where it is infrequent, and often exploited commercially. It is known to occur in the Bladen Lakes area.

Nestronia umbellula (nestronia) is ranging widely from Virginia to Alabama in the coastal plain and piedmont but is uncommon and poorly reproducing. It occurs in the Bladen Lakes area in pine flatwoods.

Alligator mississippiensis (alligator), a federally endangered species, occurs near the northern and inland limits of its range in the Bladen Lakes area, where it is known from Suggs Mill Pond, Cape Fear River, and Turnbull Creek Swamp. It is probably increasing in this area.

Picoides borealis (red-cockaded woodpecker) is a wideranging species in the southeastern US, but is considered endangered (by both federal and state governments) due to habitat loss. It is common in the Bladen Lakes area since forests with mature pines are still relatively extensive.

Ursus americanus (black bear) is the most common large wild animal in most parts of the continent, but has become rarer in the east as civilization has encroached on large tracts of wildlands. Bears are now

found in the Appalachian Mountains, and in various large coastal plain wetlands from Virginia south. It is considered a species of special concern in North Carolina, as many populations are threatened by habitat loss and hunting pressure. Studies of the bears in the Bladen Lakes have shown that they utilize a wide variety of habitats (including pocosins, longleaf pine - turkey oak sand ridges, and hardwood river swamps) for seasonal food sources. Their continued existence in the coastal plain will require areas like the proposed bay preserve.

Felis concolor (cougar) is a large predator, with a history and distribution similar to that of the black bear. Its requirement of large, relatively undisturbed wildlands is more extreme than the bear's, however, and it is almost completely eliminated from the eastern US. There are frequent reports of its presence in the Bladen Lakes area.

Hyla andersoni (pine barrens treefrog) occurs in the coastal plain of southeastern North Carolina and northeastern South Carolina, with disjunct populations in New Jersey, Georgia, and Florida. The Bladen Lakes area is probably its greatest population concentration. The wetland habitat necessary for breeding is being rapidly converted throughout its range.

In addition, many other rare plants and animals occur in the Bladen Lakes area (see Tables 1 and 2). They are considered less significant, however, because they are species having greater abundance, greater range, less development pressure on their habitats, occurrence in the vivinity of but not within a possible bay preserve, or uncertain status.

It is clear that the Bladen Lakes area represents a concentration of rare plants and animals adapted to the ecological conditions found in association with Carolina bays.

DEVELOPMENT PRESSURES

Carolina bays, and indeed inland wetlands in general, are presently being modified at an unprecedented rate. What was considered unusable land ten or twenty years ago is now under intense development pressure for agricultural, silvicultural, and recreational uses. Productivity (in the economic and societal sense) from these lands is desirable; it should and will be pursued. At present, however, development patterns are haphazard and thus disruptive to what had previously been large tracts of wild lands, considered de facto preserves. Not only are large proportions of inland wetlands being developed, but large tracts of wetlands are increasingly fragmented. This encroachment into large, previously natural areas is particularly critical for some rare plants (which are often successional species that are transient in a given spot but permanent within a larger area) and animals (which may wander over a large territory encompassing a required variety of habitats).

Present development pressures on Carolina bays are many. One of the most important is conversion of the land to row crops, principally soybeans and corn. Ditches and canals lower the water table; once drained, tillage, herbicide, and fertilizer costs are still higher than for agricultural uplands, but high average yields tend to offset the additional costs. With agricultural lands being lost to urbanization, lands such as this, which require more intensive management, are becoming increasingly tempting for agricultural companies which can afford the development capital required. Bays are also occaisionally converted to improved pasture.

Historically, timber was the only profit gained from bay lands. Timber was cut from many inland wetlands early in the 1900's. Specialty trees, such as white cedar, were particularly sought. The modern timber market in the Southeast, however, demands rapid rotation of fast-growing species. Timber companies bought large tracts of otherwise useless swamp land, and through drainage, fertilization, and improved silvicultural practices, turned them into productive timberlands. Further conversion of bay forests and pocosins continues.

Recreational development is a minor factor in bay modification when compared to agriculture and silviculture, but is significant in the Bladen Lakes area, where a concentration of the few natural lakes in North Carolina invites developers. White Lake was developed long ago; Black (Bay Tree) Lake has been greatly modified by development attempts. Other bay lakes support low intensity recreational development which scarcely affects their natural features. Carolina bays, particularly if sandy, are also subjected to drainage and urbanization.

Peat mining is a new threat to Carolina bay natural areas. As discussed earlier, bays hold substantial quantities of peat that could be mined for fuel, insulation, absorbent agent, soil improvement agent, or chemical feedstock for synthesis of organic compounds.

A combination of these development forces has led to rapid alteration of inland wetlands of the coastal plain. Richardson et al[1] estimated that in 1962 natural pocosins covered about 2,250,000 acres

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[1] Richardson, C.J., R. Evans, and D. Carr. 1981. Pocosins: an ecosystem in transition. In Richardson, C.J., ed., Pocosin Wetlands. Hutchinson Ross, Stroudsburg Pa.

in North Carolina, about 70% of the total nationwide. By 1979, only about 700,000 acres (31%) remained undisturbed. 33% had been completely developed, and 36% was in transition.

In the Carolina bays of Bladen and Cumberland counties, major conversion began only in the 1970's and has proceeded rapidly. In aerial photography of 1974, over 95% of bays were in essentially natural condition. Aerial surveying of the area in October 1981 showed roughly 60% in natural condition, 15% in the process of conversion, and 25% completely altered. If Bladen Lakes State Forest land were excluded and only private holdings considered, the percentage of bays drained and cleared since 1974 would be much higher, approaching a figure of 50%. The process has, of course, continued, and areas reported here as natural are being ditched and drained.

Fortunately, several large areas containing a variety of bays have so far remained relatively undisturbed. Prior to the 1970's the entire Bladen Lakes area, extending 35 miles long by 10 to 15 miles wide, could be considered as an essentially unified natural area, despite very localized severe development (such as White Lake) and somewhat more extensive mild development (roads, agricultural land). The natural area has now been nearly separated by major drainage and clearing operations into three large remaining tracts which are only tenuously connected along river and creek swamps. These areas, and their potentials for a bay preserve, will be the focus of the remainder of this report.

BAYS OF PRIMARY SIGNIFICANCE AND POSSIBLE BAY PRESERVES

The generally inhospitable conditions found in the bays have discouraged frequent visitation by scientists; consequently, the flora and fauna are probably more poorly known than those of any other area east of the Mississippi. Although much is known of the plants and animals which typically occur, very little is known about what actually occurs in any particular bay, and what factors govern the distribution patterns of plants, animals, and soils. For this reason, designation of bays of primary significance is difficult and provisional; in general, there is a strong correlation between the number of ground visits to a bay by natural scientists and the number of rare species, rare communities, or other significant features found. The natural features of most of the Bladen area bays remain completely unknown; aerial reconnaissance reveals general vegetation patterns but not the presence of large populations of rare species, unusual communities, or exemplary natural features.

More detailed ground inventory of the Carolina bays is greatly needed. Protection planning efforts would be greatly ameliorated by a thorough compilation of the little existing information, followed by field visits to bays by a team consisting of a botanist, a zoologist, and a soil scientist/ sedimentary geologist. The visits to bays by Lee Otte and his field crews have provided much valuable information, but most crews lack botanical and zoological expertise.

Owing to the rapid conversion of bays, the initiation of preservation efforts cannot be delayed until further information is acquired.

Preserve recommendations in this report are based on a synthesis of:

1. Available natural area inventories (protection of known significant features)
2. Knowledge of the area by a variety of agency personnel
3. Bay diversity (protection of the greatest possible diversity of bay types)
4. Contiguity of large tracts (greater than 10 square miles) of essentially natural land
5. Diversity of non-bay features
6. Presence of buffer areas and wildlife corridors with connection to other large tracts of wildland

Based on existing information, bays of primary importance include Tatum Millpond Bay (#16), Rogers Bay (#26), Suggs Mill Pond (#31), Marshy Bay (#32), Bushy Lake (#33), Summons Mill Pond (#36), Big Colly Bay (#51), Charlie Long Millpond Bay (#52), Tussock Bay (#59), Singletary Lake (#62), Sauters Lake (#117), and Caney Meadow (#119). For further information see Appendix 1 of this report.

The three remaining relatively undisturbed tracts of land with bay preserve potential are:

1. Suggs Mill Pond/Marshy Bay/Bushy Lake and vicinity
   (Preserve A)
2. Big Colly Bay/Tatum Millpond Bay/Charlie Long Millpond Bay and vicinity
   (Preserve B)
3. Colly Swamp and vicinity
   (Preserve C)

The Suggs Mill Pond/Marshy Bay/Bushy Lake is the proposed preserve. Only minor disturbance has occurred within the proposed primary boundary (see map). Several of the bays included are considered to be of primary significance (Suggs Mill Pond, Marshy Bay, and Bushy Lake), with many important rare species occurrences, including large populations of the endangered endemic Kalmia cuneata (white wicky). Other rare species occurences are Drosera filiformis (threadleaf sundew), Dionaea muscipula (Venus' flytrap), Rhynchospora alba (white beakrush), Rhexia aristosa (awned meadowbeauty), Alligator mississippiensis (American alligator), Picoides borealis (red-cockaded woodpecker), Lysimachia asperulaefolia (rough-leaved loosestrife), Ursus americanus (black bear), Hyla andersoni (pine barrens treefrog), Felis concolor (cougar), and Anhinga anhinga (anhinga).

Preserve A includes the greatest diversity of bay vegetation types known in a relatively compact area. (See maps: Roseboro SW, Roseboro NW). In addition, associated vegetation types are well represented in adjacent sand rims and swamps. Excellent examples of sand rim vegetation occur around Suggs Mill Pond, Big Gallberry Bay, Little Gallberry Bay, and Bushy Lake. The geomorphic diversity of bays is also well represented, with small to large, and sandy to peaty substrate bays represented. Many bays are overlapping, and concentric sand rims are found at Bushy Lake. Examples of open water bays (Little Singletary Lake), semi-open water bays (Suggs Mill Pond), and vegetated bays (Bushy Lake, Marshy Bay, and others) are included.

Much of the land is in large tracts owned by Canal Industries. The approximately 15 square miles within the primary boundary should be

sought through gift or purchase. This land is currently maintained as a hunting preserve for employees of the company. The secondary boundary adds approximately 20 square miles of additional bay land, non-bay upland, and hardwood river swamp. To the north, it adds Simmons Mill Pond, an excellent bay with an exceptional sand rim. To the south and northwest are bay, upland, and swamp lands considered critical for the protection of large mammals. Not only do they add to the viability of the preserve itself, but they also provide necessary wildlife corridor connections to natural areas to the south and southeast. These lands should probably be protected through easements and management agreements rather than through purchase. This land need not be removed from productive uses such as timber, but major agricultural, residential, or recreational development would be detrimental to preserve integrity.

Preserve B is centered around Big Colly Bay, Tatum Millpond Bay, Caney Meadow, and Charlie Long Millpond Bay. It occupies about 45 square miles. (See maps: Roseboro SE, Elizabethtown NE, and White Lake NW). Primary and secondary boundaries have not been drawn, but the primary boundary would include the four bays stated above, and would encompass about 15 square miles. Rare species occurrences include Dionaea muscipula (Venus' flytrap), Kalmia cuneata (white wicky), Hyla andersoni (pine barrens treefrog), Picoides borealis (red-cockaded woodpecker), and Ursus americanus (black bear).

Vegetational diversity is not as great as in Preserve A, with bays vegetated almost exclusively with bay forest and mixed pocosin types. Sand rims are also much poorer. There is less geomorphic variety, and bay lakes are not represented. The area is considered critical habitat for survival of bear in the Bladen Lakes region, however.

Nearly all of the land in Preserve B is presently included in Bladen Lakes State Forest. Present management for timber is not incompatible with this area being included in a bay preserve, perhaps with minor changes in management following recommendations of bear biologists. Preserve A and Preserve B, if connected by wildlife corridors, would make a large bay preserve which would likely achieve all goals.

Preserve C is the largest (ca. 70 square miles), most diffuse, and most disturbed area. It stretches from Tussock Bay and Big Bay on the northeast to Singletary Lake and the Cape Fear River on the southwest (See maps: White Lake SW, White Lake NW, White Lake SE). Rare species occurrences include Kalmia cuneata (white wicky), Lachnocaulon beyrichianum (Beyrich's bogbuttons), Dionaea muscipula (Venus' flytrap), and Picoides borealis (red-cockaded woodpecker).

Some excellent features are included, most notably Colly Swamp, Tussock Bay, and Singletary Lake (with associated sand rim), but high quality natural features are widely spaced with much draining and disturbance throughout. Excellent features are already recognized and protected (such as the Turkey Oak Natural Area). Bays are too diffusely distributed in this area and alteration too extensive for an effective preserve to be practical.

RECOMMENDATIONS

A Carolina bay preserve should be established in Bladen and Cumberland counties, North Carolina. The recommended preserve is the Suggs Mill Pond/Marshy Bay/Bushy Lake area. The primary area of about 15 square miles includes excellent representation of bay geomorphology, vegetation, and wildlife in a compact tract with minimal disturbance to date; no comparable area exists. The primary area should be protected through acquisition by gift or purchase. The secondary area, an additional 20 square miles, is considered necessary for the long term maintenance of the primary area and the continued integrity of all natural features. It adds further examples of Carolina bays, excellent sand rims, upland forests, and hardwood river swamps, valuable in their own right and important as buffer area and wildlife corridor connectors to other wildlands to the south and east (Bladen Lakes State Forest). The major goal of the secondary area is the maintenance of a preponderance of forested land to the south and southeast, critical for the continued existence of a bear population in the area; for this reason, suitable management agreements and easements and easements are sufficient to ensure adequate protection.

Management of the proposed bay preserve must include prescribed burning and control of heavy hunting pressure on the small bear populations. Other highly desirable management steps include:

1. Further inventory, with and beyond the preserve boundaries
2. Designation as a Biosphere Reserve of the US Man and the Biosphere Program
3. Interpretation and public education

4. Further scientific research, on rare species populations and biology, Carolina bay geomorphology, etc.
5. Maintenance or amelioration of rare species habitat.

More detailed management plans should be arrived at through the recommendations of a stewardship committee including experts on fire ecology, rare species biology, wildlife resources management, botany, and zoology.

A Carolina bay preserve should be a high priority for conservationists in the Southeast. The highly unusual and still poorly understood geomorphic nature of these features, their diverse and interesting flora and fauna, and their importance as critical habitat for many endemic and rare species, all argue for the preservation of one of the few remaining large tracts of Carolina bays. The rapid rate of bay ditching and clearing adds urgency to the establishment of a bay preserve.

APPENDIX I

This appendix presents notes on Carolina Bays and other natural features of the Bladen Lakes area of Bladen and Cumberland counties, North Carolina. Information is based principally on aerial reconnaissance in late October 1981, supplemented by interviews with knowledgeable people in the area, interpretation of aerial photography, and various reports and files of the N.C. Natural Heritage Program. Historical status of bays was determined from aerial photography taken in April 1974. Reliability for all information reported is considered good, up to fall of 1981. More detailed aerial and ground inventory would, of course, be highly desirable. This appendix is presented in a spacious format in the hopes that it may be useful as a reference that can be added to and updated as these areas are studied further (or as their condition deteriorates).

FEATURE #1 - COTTON HEAD BAY
MAP: White Lake SW, Elizabethtown SE, Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5000' long bay, with natural vegetation consisting principally of bay forest.

FEATURE #2 - BLACK CREEK (BIG) BAY
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Ditched, drained and cleared for row crops. 12,000' long bay, in natural condition prior to 1974. Substrate 1'-6' of peat.

FEATURE #3 - BAY TREE (BLACK) LAKE
MAP: White Lake NW
FEATURE TYPE: Carolina Bay (Bay Lake)
DESCRIPTION AND CONDITION: 14,000' long bay, principally open water. Extensively altered in the 1960's by drainage, dredging, and lining with sand. Current ditching, draining and clearing on the north end. 1418 acres.

FEATURE #4

MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2,000' long bay cleared for cultivation. Natural condition prior to 1974.

FEATURE #5 - TILL BAY

MAP: WHITE LAKE NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2,500' long bay, cleared for cultivation. Natural prior to 1974.

FEATURE #6

MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4,500' long bay, in natural condition. Mixed pocosin and bay forest. This and Causeway Bay (#7) are essentially isolated from other natural areas by extensive drainage and clearing in all directions.

FEATURE #7 - CAUSEWAY BAY
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,500' long bay, in natural condition. Mixed pocosin and bay forest. This and the Carolina Bay (#6) to the SE are essentially isolated from other natural areas by extensive drainage and clearing in all directions.

FEATURE #8 - HORSEPEN BAY
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,000' long bay. Ditched, drained and cleared. Previously low to medium pocosin essentially natural prior to 1974.

FEATURE #9 - SMITH MILL POND
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: No cultivation. Very wet, mostly low pocosin, but with some areas of marsh, open water, red maple swamp, cypress-gum swamp and (around the perimeter) bay forest. 10,000' long.

FEATURE #10 - REEDY BRANCH BAY
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6,000' long bay, natural condition, ca. 60% high pocosin, 20% medium pocosin and 20% bay forest.

FEATURE #11 - BEAVER DAM BAY
MAP: White Lake NW, (Clinton SW)
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8,000' long, natural condition, about 60% bay forest, the remainder high and medium pocosin. Power line cut across NE flank.

FEATURE #12
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 1,000' long, natural condition, on SW flank of Beaver Dam Bay (#11). Nearly half medium pocosin, the remainder bay forest and high pocosin.

FEATURE #13

MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 1,600' long, natural condition, associated with Beaver Dam Bay (#11). Mostly medium pocosin, high pocosin and bay forest, with some low pocosin.

FEATURE #14

MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 1,500' long, natural condition, associated with Beaver Dam Bay (#11). Mixed pocosin and bay forest.

FEATURE #15 - COTTON PATCH BAY

MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7,000' long. Low pocosin, but recent drainage has resulted in increase in pond pine and red maple. Substrate 0'-3' peat over sand and clay. Some drainage begun prior to 1974.

FEATURE #16 - TATUM MILLPOND BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 15,000' long bay, with natural vegetation. Ca. 30% bay forest, 50% various heights of pocosin, some white cedar swamp, some cypress-gum forest. Important bear habitat. Kalmia cuneata, Hyla andersoni, Ursus americanus.

FEATURE #17 - SHERIFF WHITE BAY
MAP: Elizabethtown NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,000' long bay, ditched and drained. Natural condition prior to 1974.

FEATURE #18 - McNeil Bay
MAP: Elizabethtown NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7,000' long bay, with some distrubance and encroachment around edges. Vegetation unknown.

FEATURE #19 - RAKE SHIN BAY
MAP: Elizabethtown NW, Elizabethtown SW
FEATURE TYPE: Carolina Bay complex
DESCRIPTION AND CONDITION: Multiple bays,11,000' long, in natural vegetation.

FEATURE #20 - CORSON BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3,500' long bay, disturbed by canals, roads, and power line cuts. Sandy substrate with bay forest vegetation.

FEATURE #21 - RED POND
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 1,500' long bay, condition unknown.

FEATURE #22 - SESSOMS BAY
MAP: Roseboro SW, Roseboro SE, Elizabethtown NE, Elizabethtown NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 13,000' long bay, ditched, drained and cleared. Natural prior to 1980.

FEATURE #23
MAP: Roseboro SW, Elizabethtwon NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4,500' long bay with natural vegetation of mixed pocosin types.

FEATURE #24 - BENNETTS BAY
MAP: Roseboro SW, Saint Pauls SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7,000' long bay, with some drainage. Vegetation of mixed pocosin types. Natural condition prior to 1974.

FEATURE #25 - WOLFS BAY
MAP: Roseboro SW, Elizabethtown NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2,500' long bay with natural vegetation of principally bay forest and high pocosin. Good sand ridge areas between this feature and Rogers Bay (#26).

FEATURE #26 - ROGERS BAY
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,000' long bay with natural vegetation of white cedar swamp and bay forest. One of the best white cedar areas seen. Good sand ridges to SE.

FEATURE #27 - BAKERS LAKE BAY
MAP: Saint Pauls SE
FEATURE TYPE: Carolina Bay (Bay Lake)
DESCRIPTION AND CONDITION: 7,500' long bay with open water (Bakers Lake) and much excellent low pocosin with very scattered pond pine. Sarracenia flava abundant on north end. Some islands of white cedar. A few canals and some pondbuilding activity. Good sand rim on NE flank and SE end.

FEATURE #28 - THOROUGHFARE BAY
MAP: Saint Pauls SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,000' long bay, in natural condition, with vegetation of principally medium pocosin.

FEATURE #29 - LITTLE SINGLETARY LAKE
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay (Bay Lake)
DESCRIPTION AND CONDITION: 10,000' long bay, approximately 70% open water, ringed with cypress. Remaining 30% (on the NW end) is mixed pocosin types. Partly overlaps large bay (Feature #40). Some disturbance of SE edge by clearing.

FEATURE #30 - BIG GALLBERRY BAY
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7,000' long bay, with natural vegetation of principally low and high pocosin. Peat up to 6'-7' deep. Undisturbed.

FEATURE #31 - SUGGS MILL POND (HORSESHOE LAKE)
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay (Bay Lake)
DESCRIPTION AND CONDITION: 15,000' long bay (ca. 2130 acres) with horseshoe-shaped open water (ca. 367 acres) with high diversity of vegetation types - open water aquatics, various marsh types, pitcher plant bog, cypress swamp (with domes), low pocosin, high pocosin, and bay forest. Adjoining excellent longleaf pine-turkey oak sand rims. Very large population of Kalmia cuneata, large population of Drosera filiformis, Dionaea muscipula, Rhynchospora alba, Rhexia aristosa, Alligator mississippiensis, Picoides borealis, large population of Hyla andersoni, substantial use by Ursus americanus, persistent reports of Felis concolor, reported nesting population of Anhinga anhinga, nesting population of Buteo lineatus. Some disturbance in the form of hunting access roads, wildlife and waterfowl food plot plantings, access canals around the southern and eastern edges, boat landings. High water level (3'-5') maintained by man-made dam. Peat 1'-3' deep. Geomorphically and biologically one of the most important bays remaining.

FEATURE #32 - MARSHY BAY
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 10,000' long bay, vegetated principally by low to medium pocosin, with some stands of white cedar and bay forest. A small pond occurs in the SE corner. Poorly explored. Peat 5'-6' deep. Natural condition. Jeep tracks through the longleaf pine-turkey oak sandrim.

FEATURE #33 - BUSHY LAKE
MAP: Roseboro NW, Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 12,000' long bay, with natural vegetation of principally deciduous low pocosin (Zenobia). Sandy substrate (no peat). Kalmia cuneata, Rhynchospora alba, Lysimachia asperulaefolia, Dionaea muscipula, Ursus americanus.

FEATURE #34

MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPATION AND CONDITION: 4,000' long bay, partially occluded by Suggs Mill Pond (#31). Bay forest, recently logged.

FEATURE #35 - ROUND POND

MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2,500' long bay, with mostly medium pocosin vegetation.

FEATURE #36 - SIMMONS MILL POND

MAP: Roseboro NW
FEATURE TYPE: Carolina Bays (2)
DESCRIPTION AND CONDITION: 6,000' long bay with 2,000' long included bay. Natural vegetation with ca. 30% low pocosin, 50% medium pocosin, 20% high pocosin. Excellent turkey oak sandrim on NE flank. Peat 1' deep.

FEATURE #37 - WHITE POND BAY
MAP: Roseboro SW, Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8,000' long bay with natural vegetation of principally bay forest. Sandy substrate (no peat). Some red maple forest. Power line out from NW to SE across bay.

FEATURE #38 - CYPRESS POND
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2,500' long bay, with natural vegetation of hardwood swamp.

FEATURE #39 - HARRISON CREEK SWAMP AND LITTLE ALLIGATOR SWAMP
MAP: Roseboro SW, Saint Pauls SE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Large area of swamp forest, largely clearcut in the past several years (clearing continuing at present). In good condition prior to 1974.

FEATURE #40
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7,500' long bay, with natural vegetation of bay forest and high pocosin. Adjacent to and partially overlapping Little Singletary Lake (#29). Peat 1'-5' deep over clay.

FEATURE #41 - DICKENSON MEADOW
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,500' bay, ditched, drained and cleared. A natural area prior to 1974.

FEATURE #42 - BIG BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3,500' long bay, ditched, drained and cleared. A natural area prior to 1974.

FEATURE #43 - TURNBULL CREEK SWAMP (NORTHERN SECTION)
MAP: Roseboro SE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Swamp forest, ca. 3 miles long by 2,000' wide, in good condition. Reported as bear habitat.

FEATURE #44 - MILL BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 9,000' long bay, with ca. 80% low pocosin, 20% medium to high pocosin. No cultivation. 1'-3' of peat.

FEATURE #45 - BEAR PATH BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6,500' long bay. Natural vegetation of a mixture of pocosin types. 1'-2' of peat. No cultivation.

FEATURE #46
MAP: Roseboro SE
FEATURE TYPS: Carolina Bay
DESCRIPTION AND CONDITION: 2,500' long bay, with principally high pocosin.

FEATURE #47 - BIG WHITE BAY
MAP: Roseboro SE, Roseboro NE, Roseboro NW, Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 18,000' long multiple bay. Formerly bay forest and high pocosin, now cut over. Large parts ditched and cleared. A natural area prior to 1974. Substrate of peaty sand.

FEATURE #48 - LITTLE BEAVERDAM CREEK SWAMP
MAP: Roseboro NE, Roseboro SE
FEATURE TYPE: Swamp Forest and Carolina Bay
DESCRIPTION AND CONDITION: Swamp area ca. 3 miles long by 2,000'-3,000' wide. Principally high pocosin.

FEATURE #49 - CYPRESS CREEK BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 12,500' long bay, ditched, drained and cleared. A natural area prior to 1974.

FEATURE #50 - SMITH BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8,000' long bay, with sandy and loamy substrate (no peat). Natural vegetation of bay forest and hardwood swamp forest. Timbered in the past but has grown back up.

FEATURE #51 - BIG COLLY BAY
MAP: Elizabethtown NE, Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 15,000' long bay with natural vegetation, primarily medium pocosin. Substrate up to 3' peat. Large area utilized by bear population. Other communities: hardwood swamp, cypress-gum swamp, pitcher plant bog, bay forest, white cedar swamp. Dionaea muscipula, Kalmia cuneata, Hyla andersoni, Picoides borealis, Ursus americanus.

FEATURE #52 - CHARLIE LONG MILLPOND BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6,500' long bay, with natural vegetation, primarily medium pocosin, with some bay forest. Dionaea muscipula, Kalmia cuneata, Hyla andersoni, Picoides borealis, Ursus americanus

FEATURE #53

MAP: Elizabethtown NE, White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7,000' long bay, with natural vegetation consisting primarily of medium pocosin.

FEATURE #54 - BUTLER BAY

MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3,500' long bay, associated with Smith Mill Pond (#9). Bay forest almost exclusively, with much recent timbering activity.

FEATURE #55 - KELSO BAY

MAP: White Lake NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Natural. 4,000' long bay. About 50% low pocosin, 50% high pocosin.

FEATURE #56

MAP: White Lake NE
FEATURE TYPE: Bay Complex
DESCRIPTION AND CONDITION: Natural. Principal bay 3,000' long, with second 2,500' overlapping bay. Principally low pocosin. Isolated from other natural areas by developed upland to NE and drained and cleared by complex to SW (#57).

FEATURE #57 - MURPHY BAY COMPLEX (NW END)

MAP: White Lake NE, White Lake NW
FEATURE TYPE: Bay Complex
DESCRIPTION AND CONDITION: Drained and cleared for row crops. This was a complex of at least 5 or 6 bays, totaling 3 miles long and a mile wide. Natural prior to 1974.

FEATURE #58 - MURPHY BAY COMPLEX (SE END)

MAP: White Lake NE, White Lake SE
FEATURE TYPE: Bay Complex
DESCRIPTION AND CONDITION: Still largely natural, 5,000' long, essentially isolated from other natural areas. Mixed pocosin and bay forest.

FEATURE #59 - TUSSOCK BAY
MAP: White Lake SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Bay, 12,000' long, principally medium to high pocosin. Natural. Substrate 3'-8' of peat. Well-developed sandrim to NE, with arcing dune patterns.

FEATURE #60 - NORTHERN TUSSOCK BAY
MAP: White Lake SE, White Lake SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Natural bay, ca. 10,000' long, SE end obscured by superposed Tussock Bay (#59). Principally medium to high pocosin, likely with peaty substrate similar to #59.

FEATURE #61 - THUMB SWAMP
MAP: White Lake SW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Large stand of swamp forest (cypress-gum, red maple, mixed bottomland oaks) in apparently good condition.

FEATURE #62 - SINGLETARY LAKE
MAP: White Lake SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 10,000' long bay, over half occupied by the open water lake, the remainder low and medium pocosin. Excellent condition, except some recreational development on SE end. Kalmia cuneata, Lachnocaulon beyrichianum, Dionaea muscipula, Picoides borealis.

FEATURE #63 - COLLY SWAMP
MAP: White Lake SW, White Lake NW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Some cutting, principally natural, large swamp, ca. 6 miles long and 1 mile wide, reported as habitat critical for local bear population.

FEATURE #64

MAP: White Lake SE
FEATURE TYPE: Carolina Bays (2)
DESCRIPTION AND CONDITION: 2 small, natural bays adjacent to the SE end of Tussock Bay (#59). Principally medium pocosin, the remainder low or high pocosin. Each bay ca. 3,000' long.

FEATURE #65 - SMITH MILL POND

MAP: White Lake SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Previously low pocosin, but recently dammed and cypress and cypress-gum forests appear to be taking over. Sandy substrate.

FEATURE #66 - REEDY CROSSWAY

MAP: White Lake SE
FEATURE TYPE: Bay Complex
DESCRIPTION AND CONDITION: Natural complex of many small bays (largest 3,500' long). Mixed pocosin, mostly low over 1'-2' of peat.

FEATURE #67 - COLLY SWAMP (NW PORTION)
MAP: White Lake SE, White Lake SW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Large swamp area, parts recently cut, but in principally good condition. Ca. 6 miles by 2 miles wide.

FEATURE #68 - COLLY SWAMP (SE PORTION)
MAP: White Lake SE, Bolton NE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Large swamp area, parts recently cut, but in principally good condition. Ca. 4 miles long by 1 mile wide.

FEATURE #69 - BIG BAY
MAP: White Lake SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Principally low and medium pocosin. Canals have been cut, but the bay is not cleared. Natural prior to 1974. 8,000' long.

FEATURE #70
MAP: Bolton NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3,500' long bay, with natural vegetation, predominatly low to medium pocosin.

FEATURE #71 - OTTER SLIDE BAY
MAP: BOLTON NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5,500' long bay, with natural vegetation, consisting primarily of low pocosin.

FEATURE #72 - CONKILL BAY
MAP: White Lake SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Mixed pocosin and bay forest. Drained and partly cleared. Natural prior to 1974.

FEATURE #73 - PRIDGEN FLATS
MAP: White Lake NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Mixed pocosin and bay forest originally, now largely drained and cleared. In 1974 NW corner had been drained and cleared for agriculture. Drainage continued since. Road across NW end. 7,000' long.

FEATURE #74 - SOUTH RIVER SWAMPS (KERR MARSH)
MAP: White Lake NE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Swamp forest, mostly fairly recently cut over. Some areas cleared for pasture or row crops. Ca. 7 miles long by 0.5 to 1 mile wide.

FEATURE #75 - LAKE CREEK SWAMP (NW SEGMENT), GINGERBERRY ISLAND, BIG ISLAND
MAP: White Lake NE, White Lake NW, White Lake SE, White Lake SW
FEATURE TYPE: Swamp Forest, Sand Ridges
DESCRIPTION AND CONDITION: Drained (where necessary) and cleared for row crops. Almost entirely natural prior to 1974.

FEATURE #76 - LAKE CREEK SWAMP (SW SEGMENT)
MAP: White Lake SE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Ca. 3 miles long by 1000' wide. Swamp forest, some cutting, but mostly reasonably mature.

FEATURE #77 - LYON SWAMP
MAP: White Lake SE, Bolton NE
FEATURE TYPE: Swamp and Associated Uplands
DESCRIPTION AND CONDITION: Largely developed.

FEATURE #78 - BLACK RIVER SWAMPS
MAP: White Lake SE, Bolton NE, Acme NW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Large tract of swamp forest, some cutting, mostly in good condition, but isolated from bays to its west by upland development along Highway 210.

FEATURE #79 - WALKER'S BLUFF
MAP: White Lake SW
FEATURE TYPE: River Bluff
DESCRIPTION AND CONDITION: Shell limestone outcropping along river, containing diverse assemblage of Cretaceous marine fossils. Peripheral Asplenium resiliens, endangered Asplenium heteroresiliens.

FEATURE #80 - CAPE FEAR RIVER SWAMPS
MAP: White Lake SW, (Elizabethtown SE), (Bolton NW)
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Large, principally undisturbed area of mixed hardwood and cypress-gum swamps, ca. 1 mile wide by 8 miles long. Probably important bear habitat and refuge.

FEATURE #81 - SINGLETARY LAKE SAND RIDGES
MAP: White Lake SW
FEATURE TYPE: Sand Ridges
DESCRIPTION AND CONDITION: Extensive area of carolina bay sand rim with associated arcing dune fields. Largely preserved in the Turkey Oak Natural Area. Exclusion of fire has resulted in unusual predominance of hardwoods. Dionaea muscipula, Kalmia cuneata, and Lachnocaulon beyrichianum in wetter areas adjoining Picoides borealis, Plecotus rafinesquii.

FEATURE #82 - DOG BAY
MAP: White Lake SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long carolina bay in natural condition. Medium to high pocosin and bay forest.

FEATURE #83 - BRIAR POND
MAP: White Lake SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2000' long carolina bay in natural condition. Pocosin and bay forest.

FEATURE #84 - SPRING BAY
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5000' long bay in natural condition. Mixed pocosin and bay forest.

FEATURE #85 - FLOODGATE BAY
MAP: White Lake NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 1000' long bay in natural condition. Mostly medium and low pocosin.

FEATURE #86 - WHITE LAKE
MAP: White Lake NW, Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 9000' long bay, almost completely open water, extensively developed for recreation. Small portion of NW end remains natural, with Lachnocaulon beyrichianum, Fothergilla gardenii, Sagittaria teres, Habenaria flava.

FEATURE #87 - COLLY SWAMP
MAP: White Lake NW, Elizabethtown NE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: A rather narrow band of swamp forest along Colly Creek, ca. 10 miles long by 1000'-2000' wide. Some timbering, but on the whole still natural land. Bear reported in the northern parts of this area.

FEATURE #88 - SOUTH RIVER SWAMPS, CROMARTIE MARSH, KERR MARSH
MAP: White Lake NW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: A large, mostly undisturbed (except by some timbering) swamp area, ca. 3 miles long by 1 mile wide. Isolated from bays to the west by extensive upland development along Highway 210.

FEATURE #89 - LITTLE SAWMILL BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long multiple bay with natural vegetation. Mixed pocosin and bay forest.

FEATURE #90 - SAWMILL BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6500' long multiple bay with natural vegetation. Mixed pocosin and bay forest.

FEATURE #91 - SCHOOLHOUSE BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long bay with natural vegetation. Mixed pocosin and bay forest.

FEATURE #92
MAP: Elizabethtown NE, Elizabethtown SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long bay with natural vegetation, principally bay forest. Sand substrate, little organic.

FEATURE #93
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2000' long bay, ditched, drained, and cleared for cultivation. Natural prior to 1974.

FEATURE #94 - DITCH BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, with natural vegetation.

FEATURE #95
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2500' long bay, with natural vegetation, bay forest and high pocosin.

FEATURE #96
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long bay, with natural vegetation of mixed pocosin and some bay forest.

FEATURE #97
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 1800' long bay, with natural vegetation of mixed pocosin and bay forest.

FEATURE #98 - COTTON HEAD BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5000' long bay, natural vegetation of mixed pocosin including low pocosin.

FEATURE #99 - CEDAR BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long bay, natural vegetation of high pocosin and bay forest.

FEATURE #100 - SMITH'S MILL BAY
MAP: Roseboro NW, (Saint Pauls NE)
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8000' long bay, natural condition except for power line cut. Mixed pocosin types and bay forest with deep pear (6'-7').

FEATURE #101 - BUCKS BAY
MAP: Roseboro NW, (Saint Pauls NE)
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, natural condition except for power line cut. Vegetation of mixed pocosin and bay forest. Deep peat (5'-6').

FEATURE #102 - HARRISON CREEK BAY
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay Complex
DESCRIPTION AND CONDITION: 16,000' long bay, ditched, drained, stripped of 4'-5' of peat. Partly disturbed prior to 1974.

FEATURE #103 - BLACK GROUND BAY
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3500' long bay, with natural vegetation of various pocosin types. Peat depth 7'. Excellent sand rim to NW. Overlapping Simmons Mill Pond.

FEATURE #104 - NORTHERN BIG WHITE BAY
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: NW-most bay of Big White Bay complex. Some mixed pocosin, much ditched and cleared. 2'-3' of peat.

FEATURE #105
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4500' long bay, with natural vegetation of mixed pocosin types. Sandy substrate (no peat).

FEATURE #106 - THE POCOSIN
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5000' long bay with mixed pocosin types underlain by clayey sand.

FEATURE # 107 -ROLLINS BAY AND SOUTHERN HARRISON CREEK BAY
MAP: Roseboro NW
FEATURE TYPE: Carolina Bays
DESCRIPTION AND CONDITION: 10,000' bay complex, new canals in, soon to be cleared. High pocosin, cypress-gum swamp and bay forest.

FEATURE #108
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8000' long bay, with high pocosin and bay forest, largely ditched and drained. Sandy substrate (no peat).

FEATURE #109 - DISMAL BAY
MAP: White Lake SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Natural. Mature bay forest (Gordonia to 18" DBH). Substrate 3' peaty sand over clay. Owner: Steve Peterson. 3500' long bay.

FEATURE #110 - ROWAN SWAMP/COLLY SWAMP
MAP: White Lake SE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Nearly a square mile, some dirt roads and lumbering. Bay forest, red maple swamp, and white cedar swamp over sandy substrate.

FEATURE #111
MAP: Roseboro SW
FEATURE TYPEL Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, partly occluded by Marshy Bay (#32), undisturbed except for a power line cut. Vegetation of mixed pocosin types, with pond pine. Peat 3' deep.

FEATURE #112 - BULLARD POND
MAP: Roseboro NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6000' long bay, mostly drained, cleared and cultivated. One of the very few bays already cultivated prior to 1974. Silty substrate, no peat.

FEATURE #113 - BIG POND BAY
MAP: Roseboro NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, uncultivated, with sandy substrate (no peat). Vegetation a mixture of cypress-gum, bay forest, and mixed pocosin. Completely surrounded by cultivated uplands.

FEATURE #114 - DAVID GAM BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 10,000' long bay with natural vegetation of medium to tall pocosin. Up to 2' of peat.

FEATURE #115 - OLD HOUSE BAY
MAP: White Lake SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Natural condition (road slightly intersects NE flank), with red maple swamp forest, mixed pocosin (mostly high) and bay forest vegetation. Sand substrate. 6000' long.

FEATURE #116 - TEDDER BAY
MAP: White Lake SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: Ditched, drained and cleared. 5'-8' of peat. 9000' long. Natural prior to 1974, with principally low pocosin vegetation.

FEATURE #117 - SALTERS LAKE
MAP: Elizabethtown NW, Elizabethtown NE
FEATURE TYPE: Carolina Bay (Bay Lake)
DESCRIPTION AND CONDITION: 8000' long bay, nearly half an open water lake. Considered the best protected of the open water bays of Bladen Lakes State Forest. Other than the lake, vegetation of low to medium pocosin, cypress-gum swamp and bay forest. Picoides borealis on nearby uplands. Water up to 9' deep. Peat 4'-9' deep.

FEATURE #118

MAP: White Lake SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5000' long, low and medium pocosin. Canals cut but no clearing or cultivation yet. Natural prior to 1974.

FEATURE #119 - CANEY MEADOW

MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6000' long bay with natural vegetation, approximately 30% each of bay forest, high pocosin, and medium pocosin, and 10% low pocosin. Also several stands of white cedar. Heavy use by bears. Hyla andersoni. Peat up to 8' deep.

FEATURE #120 - JOHNSON MILL BAY

MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8000' long bay with natural vegetation, principally bay forest with some pocosin. Peat 1'-7' deep.

FEATURE #121 - JONES LAKE
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay (Bay Lake)
DESCRIPTION AND CONDITION: 8000' long bay, with 224 acre lake. The remainder is natural pocosin vegetation. Recreational development at SE end but otherwise undisturbed. Dionaea muscipula. Some white cedar-gordonia-cypress swamp. Peat up to 11' deep, one of the thickest deposits in the Bladen Lakes area.

FEATURE #122 - CYPRESS BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4500' long bay with natural vegetation of bay forest and pocosin. Some pitcher plant bog. Used by bears. Peat up to 5' deep.

FEATURE #123 - GUM SWAMP
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6500' long bay, natural vegetation, largely bay forest, some pocosin, some cypress-gum swamp. Up to 5' of peat.

FEATURE #124

MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, with natural vegetation, mostly bay forest with some medium and high pocosin. Up to 6' of peat.

FEATURE #125 - WAM SQUAM BAY

MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3500' long bay, with natural vegetation, mostly high pocosin and bay forest. Some cypress-gum swamp. Up to 5' of peat.

FEATURE #126 - CHURCH BAY

MAP: White Lake NW, Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 12,000' long bay, once largely swamp forest, bay forest and high to medium pocosin. Most now ditched, drained and recently timbered. Area on SW flank was cultivated in the past, now abandoned. Peat up to 2' deep.

FEATURE #127 - BUCKHORN BAY
MAP: Roseboro NW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 6000' long bay, natural vegetation of bay forest and pocosin, 0'-2' of peat.

FEATURE #128
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, with natural vegetation of mixed pocosin types. Peat up to 2' deep.

FEATURE #129 - LITTLE GALLBERRY BAY
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3500' long bay, with natural pocosin vegetation. Peat 1'-2' deep.

FEATURE #130 - BIG BAY COMPLEX
MAP: White Lake SE
FEATURE TYPE: Bay Complex
DESCRIPTION AND CONDITION: Big Bay (5000' long) and two small overlapping bays (each 2000' long), one of which almost entirely occludes the other. No cultivation, but canals have been cut. Principally bay forest.

FEATURE #131
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long bay with natural vegetation of high pocosin and bay forest.

FEATURE #132 - BLOODY BRANCH BAY
MAP: Elizabethtown NE, Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay, condition unknown.

FEATURE #133 - TURNBULL CREEK SWAMP (SOUTHERN SECTION)
MAP: Elizabethtown NE, Roseboro SE
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Strip of swamp forest 3 miles long, 2000'-3000' wide, in good condition. Much mature hardwood swamp, with cypress-gum swamp in sloughs. No apparent recent timbering.

FEATURE #134 - LITTLE COLLY BAY
MAP: Elizabethtown NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 7000' long bay with natural vegetation, a mixture of bay forest and high and medium pocosin.

FEATURE #135 - PETERS CREEK BAY
MAP: Roseboro SE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 9000' long bay, timbered but grown back up. Bay forest and medium to high pocosin.

FEATURE #136

MAP: Roseboro SW
FEATURE TYPE: Rare Species Location
DESCRIPTION AND CONDITION: Red-Cockaded Woodpecker (Picoides borealis).

FEATURE #137 - BOB PETERSON BAY

MAP: Bolton NE
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 2500' long bay, with natural vegetation of bay forest. Completely isolated from other natural areas by agricultural uplands.

FEATURE #138

MAP: Roseboro SW
FEATURE TYPE: Rare Species Location
DESCRIPTION AND CONDITION: Lewis' Heartleaf (Hexastylis lewisii). Needs verification.

FEATURE #139

MAP: Roseboro SW
FEATURE TYPE: Rare Species Location
DESCRIPTION AND CONDITION: Red-Cockaded Woodpecker (*Picoides borealis*).

FEATURE #140 - WHITE OAK SWAMP

MAP: Roseboro SW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Very large swamp, ca. 4 miles long by 1.5 miles wide. Some timbering operations but in fundamentally good condition. Important bear habitat.

FEATURE #141 - GUM SWAMP BAY

MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 8000' long bay, with natural vegetation of primarily bay forest and high pocosin. *Picoides borealis* in area.

FEATURE #142 - TURNBULL CREEK SWAMP
MAP: Roseboro SW
FEATURE TYPE: Swamp Forest
DESCRIPTION AND CONDITION: Narrow band (1000' wide) of hardwood swamp along Turnbull Creek. Some encroachment by agricultural fields and by timbering. Essentially natural condition.

FEATURE #143 - GRIFFIE DRAIN
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 4000' long bay. Natural condition (?).

FEATURE #144 - CEDAR SWAMP BAY
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 5000' long bay, cleared and cultivated in the 1940's, now abandoned.

FEATURE #145 - BUSHY BAY
MAP: Roseboro SW
FEATURE TYPE: Carolina Bay
DESCRIPTION AND CONDITION: 3000' long bay, with several canals and clearing visible in the 1974 photography. Present condition unknown.

APPENDIX II

The following is a listing of persons with knowledge about and/or an interest in the Carolina bays found in the Bladen and Cumberland counties area. Many were contacted either formally or informally as a part of this study. They are people who would be useful in further protection planning in the area.

Dr. Lee Otte
Dept. Geology
East Carolina University
Greenville NC 27834

Dr. Otte is a sedimentary geologist with extensive experience in the North Carolina coastal plain. He has the most extensive field knowledge of the community ecology and peat resources of Carolina bays.

Roger Lieb
USDA, Soil Conservation Service
Bladen County Soil Survey
Elizabethtown NC
919-862-4245

Mr. Lieb is familiar with the soils of the county, and with the condition and potential of land there, having visited most of the area in field surveys.

Joe Gallehugh
USDA, Soil Conservation Service
Elizabethtown, NC
919-862-2532

Mr. Gallehugh is familiar with the soils of Bladen County and their potential uses.

Aubrey Shaw
Lakewood Consolidated High School
Roseboro NC
919-525-4495

Mr. Shaw is knowledgeable about the Bladen Lakes area. He knows landowners and would be helpful in initial contacts.

Claude Hood
Superintendent
Bladen Lakes State Forest
Elizabethtown NC
919-588-4964

Mr. Hood is extremely knowledgeable of all aspects of the area.

Robert J. (Joe) Hamilton
SC Wildlife and Marine Resources Department
Bonneau SC 29431

Mr. Hamilton has studied bear populations in the Bladen Lakes area.

Dr. J. Larry Landers
Southlands Experimental Forest
Bainbridge GA 31717

Dr. Landers studied bears in the Bladen Lakes area and is familiar with its mammal populations.

Dr. Albert E. Radford
Dept. Biology
UNC-CH
Chapel Hill NC 27514

Dr. Radford is very knowledgeable of the plant species and communities of North Carolina and their protection significance and status.

Tim Nifong
Dept. Biology
UNC-CH
Chapel Hill NC 27514

Mr. Nifong has conducted natural area inventories of Carolina bays, particularly the clay-based bays.

Dr. Norman Christensen
Dept. Botany
Duke University
Durham NC 27706

Dr. Christensen has done extensive research on fire-influenced ecosystems in North Carolina. Many of his students have also done research in this field.

Ray and Patricia Ashton
NC State Museum of Natural History
Raleigh NC 27611

The Ashtons prepared an ecological inventory of the Suggs Mill Pond area in 1979 for the NC Natural Heritage Program. They are experienced biologists familiar with the flora and fauna of the site.

John Taggart
Division of Parks and Recreation
Raleigh NC 27611
919-733-7795

Mr. Taggart is an experienced botanist involved with protection planning in the state parks system. He is familiar with the area.

Julie Moore
NC Natural Heritage Program
P.O. Box 27687
Raleigh NC 27611
919-733-7795

Ms. Moore is an experienced field botanist. Her expertise is particularly great in coastal plain botany.

Jay Carter
P.O. Box 891
Southern Pines NC 28387
919-692-9358

Mr. Carter is familiar with the natural history and fire ecology of the upper coastal plain.

Dr. Henry Wilbur
Dept. Zoology
Duke University
Durham NC 27706

Dr. Wilbur has done extensive research on the fauna, specifically amphibian, of the upper coastal plain of North Carolina.

Dr. Peter Weigl
Dept. Biology
Wake Forest University
Winston-Salem NC

Dr. Weigl has studied coastal plain animal ecology, specifically small mammals.

Rob Sutter
Pesticide and Plant Protection Division
Dept. Agriculture
Raleigh NC 27611
919-733-7610

Mr. Sutter is familiar with locations and species biology of rare plants of North Carolina.

Dr. Roy Ingram
Dept. Geology
UNC-CH
Chapel Hill NC 27514

Dr. Ingram is the principal investigator of an ongoing US Dept. of Energy grant studying peat resources in North Carolina.

Dr. Lewis Anderson
Dept. Botany
Duke University
Durham NC 27706

Dr. Anderson is a bryologist very knowledgeable of the natural history, specifically mosses, of the area.

George Tilley
Jim Pridgen
Canal Industries, Inc.
304 Southern National Bank Building
Lumberton NC 28358
919-739-2887
919-862-4147

Mr. Tilley and Mr. Pridgen are familiar with Canal's Sugg Mill Pond property.

APPENDIX III

LANDOWNERS: ROSEBORO NW (Cumberland County)

NAME	ACREAGE	ADDRESS	MAP CODE NUMBER (Map-Block-Parcel)	DEED NUMBER
Smith, B.	part of 88.5 ac.	Bobby Smith & Wife Nancy Rt. 5, Box 189B Fayetteville, NC 28301	143-158-5	2834-537 853-072
Beaver, C.	15 ac.	Clarence Beaver Rt. 5 Fayetteville, NC 28301	143-158-125	
Smith, A.H.	18 ac.	Austin H. Smith Rt. 5 Fayetteville, NC 28301	143-158-94	2803-657
Cole, M. & Eure R.	Part of 167 ac.	Mary Cole & Ruth Eure 208 Woodcrest Rd. Fayetteville, NC 28305	143-158-131.1	2685-149
Herndon	47.20 ac.	Maola Herndon (life estate) Rt. 5 Fayetteville, NC 28301	143-158-94.1	2602-185
Simmons, VT & D	34.09 ac.	Virginia Thomas & Doris Simmons Rt. 5, Box 269 Fayetteville, NC 28301	143-158-17	2416-419 2737-667
Simmons, G.	91.92 ac. 38 ac	Glenwood Simmons Rt. 5, Box 265 B Fayetteville, NC 28301	143-158-84 143-158-18.1	2123-115 2568-500 2522-766
McClenney	38 ac.	Katherine McClenney & Husband 4732 Clintwood Dr. Portsmouth, VA 23703	143-158-18.2	2568-500 2522-763
Bedsole, OJ	180 ac.	O.J. Bedsole Rt. 5, Box 276 Fayetteville, NC 28301	143-158-12	529-9
Simmons, E	149 ac.	Earl Simmons & Wife Mildred 5513 Ramsey St. Fayetteville, NC 28301	143-158-18	2568-500 2522-772
Smith, CR	part of 150 ac.	Mrs. CR Smith Rt. 5, Box 245 Fayetteville, NC 28304	144-152-1	

NAME	ACREAGE	ADDRESS	MAP NUMBERS	DEED NUMBER
Cole, RE	66.4 ac.	Robert E. Cole & Wife 208 Woodcrest Rd. Fayetteville, NC 28305	144-158-10	2001-309
Hamra, C	76.14 ac.	Charles Hamra 230 Laguaruia Ave. Staten Island, NY 10314	144-158-8	2737-119
Bullard, M.	65.5 ac.	Margaret Bullard Rt. 9, Box 387 Fayetteville, NC 28301	144-158-129	
Moore, JP	116.72	James P. Moore 4410 Stearling St. Fayetteville, NC 28306	144-158-5	2538-309 2656-817
Burns, W.	71.56 a.	William Burns et al. Rt. 5, Box 249 Fayetteville, NC 28301	144-158-7	2826-149 2369-155
Burns, SJ	1 ac.	Samuel J. Burns & Wife Rt. 5, Box 249 Fayetteville, NC 28301	144-158-126	863-401
Burns, ML	1 ac.	Mary Louise Burns Rt. 6, Box 373 Clinton, NC 28328	144-158-7.1	3418-456 2733-133
McNeil Heirs	29 ac.	Larcenia McNeil Heirs c/o 30 Sutton Place New York, NY 10022	144-158-99	
Burns, JF	23 ac.	JF Burns Heirs et al. c/o Inez Culbreth Roseboro, NC 28382	144-158-6	2584-685
Baxley, M.	18 ac.	Murry and Randy Baxley Rt. 2, Box 152-A Fayetteville, NC 28301	144-158-97	2534-617 2850-45
Downing	33.5 ac.	N.F. Downing, Jr. Rt. 2, Fayetteville, NC 28301	144-158-11	
Pugh, R.	52.7 ac.	RC & DM Pugh Rt. 5 Fayetteville, NC 28301	144-158-93	2534-617 815-470
Perry, P.	191 ac.	Barbara Perry & Husband 1104 Walker Dr. Kinston, NC 28501	159-158-105	2475-825 PB21 PG39

NAME	ACREAGE	ADDRESS	MAP NUMBER	DEED NUMBER
Matthews, W.	232.7 a.	William Michael Matthews and wife Rt. 1 Benson, NC 27504	159-158-116	2789-123
Jessup, CB Heirs	1171.86a.	CB Jessup Heirs Rt. 5, Fayetteville, NC 28301	144-158-30	PB43 PG49
State of NC	125 ac.	State of NC Rt. 5 Fayetteville, NC 28301	159-158-102	
Hair, RJ	180 ac.	RJ & Mary Hair c/o Eleanor Hyrne 400 NW 153 St. Miami, Fla. 33169	159-158-117	
			158- -2	
			158- -3	
Smith, L.	100 ac.	Lennie D. Smith Rt. 5 Fayetteville, NC 28301	159-158-11	1072-345

LANDOWNERS: ROSEBORO SW (Cumberland County)

NAME	ACREAGE	ADDRESS	MAP NUMBER (Map-Block-Parcel)	DEED NUMBER
Jessup Heirs	1178.86a.	C.B. Jessup Heirs Rt. 5, Box 245 Fayetteville, NC 28301	144-158-30 145-158-3	PB43 PG49
Canal Indt.	157.0 ac. 4.37 ac. 445 ac.	Canal Indt., Inc. Box 830 Conway, SC 29526	145-158-2 145-158-1 160-158-31	
Matthews, W.	232.6 ac.	William Michael Matthews & Rt. 1 Benson, NC 27504	159-158-116	2789-123
Perry	191 ac.	Barbara Perry & Husband 1104 Walker Dr. Kinston, NC 28501	159-158-105	2475-825 PB21 PG39
Gray	269 ac.	Willie W. Gray 123 Ranch Dr. Elizabeth City, NC 27909	160-158-1 174- -51 174- -44	
Johnson, B.	90 ac. 136 ac.	Bobby Johnson & Wife Rt. 4, Box 735 D Spring Lake, NC 28390	175-158-54 175-158-53	2475-600 9658-19
Johnson, W.	91.55 ac. 64.15 ac. 70 ac.	William Johnson & Wife 3952 Duncan St. Loris, SC 29569	175-158-2 175-158-1.1 175-158-1	2664-392 2664-391
Avery Heirs	40 ac.	Bate Avery Heirs Rt. 5 Fayetteville, NC 28301	175-168-66	
Kim	50 ac.	Kum Seong Kim &Chang Chee 2013 Sandlewood Bay City, TX 77414	175-158-62	2800-615 2600-329
Thompson	40 ac.	Hansel Thompson 240 Whiton St. Jersey City, NJ 07304	175-158-72	2183-214

LANDOWNERS: ROSEBORO SW (Bladen County)

NAME	ACREAGE	ADDRESS	PLOT #, PHOTO #	TOWNSHIP & DEED NUMBER (if known)
Melvin	20.9 a.	William Harold Melvin White Oak, NC 28399	11-A; F-1	White Oak 254-143
Barbour	36 a.	Thomas R. Barbour Rt. 5, Box 259-B Fayetteville, NC 28301	12;F-1	White Oak 212-264 226-167
Canal Indt.		Canal Indt, Inc. Box 830 Conway, SC	7;G-1 3;H-4 9;G-1 10;G-1 14;G-1 6;H-2 3;H-2 5;H-2 22;G-2 21;H-3 17;H-3 18;H-3 1;I-3 12;I-3 32;I-2 34;I-2 27;I-2 30;I-2 33;I-2 1;H-2	White Oak White Oak White Oak White Oak White Oak White Oak Turnbull Turnbull Turnbull Turnbull Turnbull White Oak
Rice	61.4 ac.	Frank B. Rice 1109 Hope Mills Pond Rd. Fayetteville, NC 28304	15;F-1	173-164
Faircloth	11.8 a.	Lucille Faircloth Rt. 5, Box 255 Fayetteville, NC 28304	11;F-1	
Garcia	82.53 ac.	Francisco Garcia, et al. 427 Walnut St. Cary, NC 27511	1;G-1	White Oak 198-166
Smith, C.	62 a. 136 a.	Cecil Smith Rt. 5, Box 19A Fayetteville, NC 28301	6;G-1 5;G-1	White Oak

NAME	ACREAGE	ADDRESS	PLOT #; PHOTO #	TOWNSHIP & DEED NUMBER (if known)
Rich, ME	69 a.	Mary Ellen Rich Rt. 1, Garland, NC 28441	8;G-1	White Oak 227-847
McLeod	99 a.	Janet W. McLeod 1139 Offshore Dr. Fayetteville, NC 28305	11;G-1	White Oak 240-653
Faircloth	100.15 a. 24 a./plot	Earl Faircloth Rt. 1 Box 64 White Oak, NC 28399	12;G-1 13;G-1	White Oak 181-99
Edge, MK	190.7 a.	MK Edge Rt. 5 Fayetteville, NC 28301	2;G-2	White Oak
Kaufman	1429 a.	CZ Kaufman, Jr. c/o George M. Kaufman One Bank Street Norfolk, VA 23510	5;G-2	160-299
Smith	80 a.	Fletcher J. Smith c/o Fletcher Smith 12613 Kevanaugh Lane Bowie, MC 20713	6;G-2	White Oak
Smith	7 a.	Thomas E. Smith Rt. 5, Box 361 B Fayetteville, NC 28301	14;G-2 15;G-2	White Oak
Allen, BC		B.C. Allen P.O. Box 6588 Raleigh, NC 27628	6;G-3	
Smith		Cecil C. Smith Rt. 5, Box 19-A Fayetteville, NC 28301	12;F-3	
Moore		Margaret Moore 3920 Donna St. Fayetteville, NC 28306	1;G-3	
Lyons		Dr. Charles A. Lyons, Jr. Fayetteville State University Fayetteville, NC 28301	53;G-4	

NAME	ACREAGE	ADDRESS	PLOT #; PHOTO #	TOWNSHIP & DEED NUMBER (if known)
Fletcher		Ruby S. Fletcher White Oak, NC 28399	52;G-4	White Oak
Brown		Doss Brown P.O. Box 27 White Oak, NC 28399	57;G-4	White Oak
Smith, GH		G.H. Smith Heirs c/o Mrs. Miriam Grubb White Oak, NC 28399	56;G-4	White Oak
Georgia Pacific Corp.		Georgia Pacific Corp. P.O. Box 1808 Augusta, GA 30903	41-E;G-4 29;G-4	White Oak White Oak
Cain, PG		P.G. Cain White Oak, NC 28399	28;G-4	White Oak
Federal Paper Board		Federal Paper Board Bolton, NC 28423	30;G-4	White Oak
International Paper Co.		International Paper Company 4354 Market St. Wilmington, NC 28403	4;H-4 14;H-3	White Oak
Dunn		Robert L. Dunn Rt. 1 White Oak, NC 28399	2;H-4	White Oak
Horne		John B. & Jean S. Horne Rt. 9, Box 728 Fayetteville, NC 28301	1;H-4	White Oak
Smith		Eddis James Smith 1514 Cardiff Dr. Fayetteville, NC 28304	3;H-3 6;H-3 7;H-3	White Oak
			5;H-3	White Oak
			4;H-3	White Oak
Green Bros.		Green Brothers Lumber Co. Elizabethtown, NC 28337	11;H-3 2;H-2 7;H-2	White Oak

NAME	ACREAGE	ADDRESS	TRACT #;PLOT #	TOWNSHIP & DEED NUMBER (if known)
Owen		JA Owen 310 Wilkes Rd. Fayetteville, NC 28306	10;H-3	White Oak
Langston		Fredrick M. Langston 5119 Cooper Rd. Fayetteville, NC 28301	9;H-3	White Oak
Suggs		W. Halford Suggs c/o Robert L. Dunn White Oak, NC 28301	12;H-3	White Oak
Allen		B.C. Allen Jr. P.O. Box 6588 Raleigh, NC 27628	24;H-3	White Oak
Owen, L.		Laddies E. & Betty Owen 1050 Cottingham Rd. Reynoldsburg, Ohio 43068	12-A;H-3	White Oak
Bryant		Joseph Bryant 128 Ann Marie Dr. Charlotte, NC 28210	16;H-3	White Oak
Broadwell-Brolanco Corp.		Broadwell-Brolanco Corp. P.O. Box 53587 Fayetteville, NC 28305	20;H-3	White Oak
Davis		Bobby Malby Davis Rt. 5, Box 345 Fayetteville, NC 28301	11-A;I-3	
Edge, VD	227.84 a.	Braxton D. and Wife Eva Edge Rt.5, Box 347 Fayetteville, NC 28301	3;I-3	Turnbull
Paschal	25 a.	Mrs. L.B. Paschal c/o Lewis G. Paschal P.O. Box 322 Elizabrthtown, NC 28337	31;I-2	Turnbull
Parks	50 a.	Roy H. Parks Terrace Hill Ithaca, NY 14850	29;I-2	Turnbull
Melvin	118 a.	Byron E. Melvin Rt. 1, Box 64 Elizabethtown, NC 28337	25;I-2	Turnbull